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Article:	Climate Change and Socio-Economic Impacts: Determinants of Vulnerability for Developing Countries
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ABSTRACT

Climate change is the connected system of solar cycle that creates fluctuations weather arrays across tropics to poles. Anticipated climate changes for the 21st century have been encountered complex challenges for humanity that significantly influence over diverse components such as environmental, ecological, socio-political and socio-economic systems among others. This study incorporates a desk literature review and at the first step researchers shortlisted the keywords regarding climate change, socioeconomic impacts and determinants of vulnerability. Mixed method approach applied for this desk review. Numerous online search engines such as Google, Google Scholar, Scopus, Web of Science and Springer were selected to review the published research studies. The collected data comprises on various forms such as book chapters, books, research articles, reports, working papers, organizational evaluation studies and conferences papers. After strict inclusion and exclusion criteria researchers gathered to 89 studies from 31 publications outlets, which were interrelated to different search engine and covering climate change impacts on developing countries. The findings endorsed the climate change socio-economic impacts are more severe particularly in developing countries of south Asia like Pakistan. The astonishing and spatial heterogeneities are the clear indications for comprehensive integrated interventions, policies and procedure to eliminate or reduce socio-economic climate change impacts of developing countries.

Keywords: Climate change, Socio-economic impacts, Determinants of vulnerability, Environmental degradation, climate change and developing countries.

1. Background

Climate change is a long lasting shift in the weather patterns across tropics to poles that's reshaping world's structures and become a global threat that has embarked on to put stress on numerous sectors especially among developing countries (Chandio et al., 2023). Climate change is the connected system of solar cycle that creates fluctuations in temperature but during the recent decade's human activities drives profound effects on our planet. Anticipated climate changes for the 21st century have been encountered complex challenges that significantly influence over diverse components such as environmental & ecological system, socio-political and socio-economic systems among others (Kaini et al., 2022; Niu et al., 2023). These impacts disrupting the basic natural, social and economic systems humans largely depended on. The availability & functionality of basic livelihood, production & supplies of food, industrial & financial infrastructure, mutilation of human and global development largely associated with the rapid process of climate changes (Tahir et al., 2023).

The impacts of climate change on plant already observed since the beginning of twentieth through various factors such as the level of sea have risen 19cm, the risk of flooding for coastal communities, droughts & heat waves are more intense and changed rain patterns among different parts of the world (Chandio et al., 2020; Solomon et al., 2021). Due to this uncertain transformation of environment modes, the South America, Southern part of Europe, central Africa & south Asia yields crops and livelihood are gradually declining (EB et al., 2021). More frequent and serious events happen during recent past in developing countries that are responsible for billions of costs and severe consequences on humanity such as winter flood & record rainfall in England and Wales in 2013-14, summer heat wave and wildfire in Europe in 2018 and unprecedented global warming among others. Unfortunately, the circumstances among developing countries are alarming with meager socio-economic conditions and require large scale shift with specific targets (Ishikawa et al., 2022; Abeysekara et al., 2023).

As the globe gets warmer, every bit of this warming matters for the vulnerable proportion across world's population (Boojhawon et al., 2021). The human societies & climate system are interconnected and largely depended on each other's, the fluctuations in climate change will impacts human livings, livelihood, social, physical, economic and demographic aspects. The socio-economic impacts not evenly disrupting individuals, groups and communities but also creates unbearable burden on national development (Lamperti et al., 2021). The socio-economic impacts of climate change will affect various aspects of human wellbeing and people face uncertainty that reduce their productivity, quality of life; they face more respiratory, depression, frustration with high rates of morbidity and mortality (Feliciano et al., 2022).

In developing countries the costs of these impacts are mostly at top-level among national gross domestic products (GDP) which eventually hides others important needs of that region. The socio-economic impacts of climate change distributed unevenly around the globe but developing countries are completely devastated, as most of the population among these countries depended a lot on their agriculture sectors, livestock and food industry among others (Hussain et al., 2020). Due to poor economic conditions these millions of vulnerable are direct victim of climate change and can result in overwhelming losses to livelihood and welfare. Major transformation like these events would also increase political conflicts, upheaval migration and mass displacement. Furthermore, these incidents are individually unlikely; they

would have broader range with severe impacts that represent huge social and economic risks (Sovacool et al., 2021).

The disruption of socio-economic conditions and its consequences are far greater risks facing by developing countries like Pakistan (Abbas et al., 2023). In the developing countries the climate change mainly disrupt the agriculture sector, decline in cereal productivity, impacts on biodiversity, human morbidity & mortality, incidents of vector born diseases, impacts on forestry, tourism, migration and above all social, psychological and economic fabric of individuals, families and countries among others (Hossain et al., 2020). The section below briefly explores the climate change impacts on human and natural environmental system in developing countries across the world. Its creates understanding that why the climate change could affect the global socio-economic demographic systems and why the most threatening risks for developing countries are directly and indirectly associated with climate change (Bibi et al., 2023).

1.1 Climate change socio-economic impacts and natural disasters

Environmental and natural disasters ratio rapidly increased in south Asian countries during recent decades. The number of natural disaster can be very from year to year and approximately more than 60,000 human live damaged globally every year (Symanski et al. 2021; Wiranata et al., 2021). The estimated figure of fatalities are meager sometimes less than 10,000 as few as 0.01% of human deaths. Climate change responsible various shocking events with devastating impacts such as famine and drought in Ethiopia 1983-85, tsunami and earthquake in Indian ocean 2004, struck Myanmar and Cyclone Nargis in 2008, Haiti port-au-prince earthquake in 2010 and pandemic of COVID in 2019 (Erman et al. 2021). These unprecedented events significantly impacted human population pushed the death over 200,000 which is more than 0.4% of global human deaths in these years. Most of the incidents with low frequency and high impacts such as tsunamis and earthquakes are not preventable but have high losses of socio-economic and livelihood of individuals and countries. The earlier detection of disaster, emergency preparedness, robust infrastructure and quick response programmes substantially reduce the risks of consequences. The poor economic conditions of residents and the governments of developing countries enhance the vulnerability. A large number of natural disasters observed during the period of 1985 to 2020 which change the life patterns and priorities of various individuals, organizations and governments as details highlighted in Table 1.

Table 1: Climate change and global natural disasters (1985-2020)

Country	1978 change	2018	Absolute change	Relative
Drought	63	0	-63	-100%
Earthquake	25162	4321	-20841	-83%
Extreme Temperature	150	536	+386	+257%
Extreme weather	3676	1666	-2010	-55%
Flood	5897	2869	-3028	-51%
Landslide	86	275	+189	+220%
Mass movements	50	17	-33	-66%
Volcanic activity	268	878	+610	+228%
Wildfire	2	247	+245	+12250%
All others natural disasters	35036	10809	-24227	-69%

Source: EM-DAT (2020)

The continent interior regions significantly impacted by temperature rising (Goes et al. 2020; Schuurmans, 2021) and the patterns of weather fluctuated due to multidimensional reasons such as shortage of natural resources, rising mercury and increase in glacier melting cause extinction to planted species (Mihiretu et al. 2021). Similarly, on the others side various viral and infectious pandemics outbreaks, seasonal livelihood, lifestyles patterns and continues transformation happen in individuals, families and community life (Abbass et al., 2021). Resulting from these circumstances insufficient adaptation and shortage of appropriate infrastructure are hammering the most.

In addition to the said observations unawareness, lack of basic environmental education, outdated consumer practices, scarcity of innovations, lack of policy legislation and least interest by the governments regarding commitment to deal with climate change challenges contrite a lot in existing situations. According to the United Nations report on environmental impacts by the 2050 a 2% to 3% rise expected in mercury which become the drastic shifts in weather patterns and enhance rainfall that have serious socio-economic consequences (Huang et al. 2022)

Climate change has momentous contribution for social wellbeing of individuals, families, communities and the nations for the rapid exaggeration and dissemination of specific quality of life aspects. In editions to comprehend impacts of climate change on agriculture, health and forestry among others it has social and psychological implications on numerous vulnerable developing countries (Pal, 2021). Climate change boosts the chronic desperation, anxiety and distresses that pushing population towards various psychological issues. Exposure to high level climate catastrophes and geological distress imprints posttraumatic disruption and ubiquitous occurrence paves the way to beginning psycho-social dysfunction (Association, 2020).

Sustainable climate and conducive environmental circumstances significantly added in productivity, economic growth and development of individuals and the countries (Mosavi et al. 2020). Increasing global existence and its association with economic development, climate change has become the critical concern for international and regional policy makers (Ferreira et al. 2020; Gleditsch 2021). The adverse economic impacts of climate change on the overall productivity factor of agriculture, an industrial and corporate sector that's leads towards harmful consequences of socio-demographic aspects of individual and families.

Empirical evidences from previous studies (Chandioet al. 2020; Gleditsch 2021) regarding climate change impacts have forecasted its economic effects on all sphere of life. The evidences incorporated the impacts of climate change on various socio-economic activities and their interrelated connectivity with numerous other aspects of development. The economic development of various developing countries has been delicate, reliant and susceptible to climate change which influence different factors that yields of humans (Wu, 2020; Alhassan, 2021)

1.2 Determinants of Vulnerability for Developing Countries

Vulnerability generally refers to the extent to which climate change may impacts the natural environment and ecosystem of globe or any specific region (Murshed, 2022). The regional climate change impacts and allied determinants of vulnerability in developing countries contribute a lot in socio-economic and demographic aspects of residing population.

Some major determinants of vulnerability which significantly associated with climate change impacts are discussed in details as under.

1.2.1 Climate change impacts on agriculture sector

The agriculture sector is the ultimate responsible to fulfill the desire food needs of world's population. Globally, the sector is accountable for 30% to 40% of overall greenhouse emissions, which predominantly contributing and significantly impacted climate conditions (Ortiz et al., 2021). A large number of climate and agro-environmental factors that have superseding impacts on agriculture productivity in response to precipitation extremes such as droughts, forest fire, rainfall and floods among others. The destructive climate change impacts induced environment extremes to deteriorate production and integrity of crops. The variety and productivity of crops persistently impacted due to fluctuations in integral biotic aspects such as environmental degradation, heating temperature, precipitation, solar radiation and CO₂ among others (Ahmed et al., 2022).

Fate of agriculture sector and decline in cereal productivity are vastly vulnerable to these climate changes that pose severe impacts on crop growth in developing countries. Decline trends in agriculture sectors, challenges the former's social status, economic conditions, livelihood, health conditions and demographic aspects among others. Agriculture development in an essential component of economic development of families especially in developing countries like Pakistan, where families economic development and potential wellbeing large depended on this sector (Rehman et al., 2021).

1.2.2 Climate change impacts and human health

The most decisive and understood corporality that the health conditions of humans is a direct and indirect victim of climate change. The World Health Organization (WHO) indicated that climate change could be responsible for more than 250,000 additional human deaths per year during the period of 2030 to 2050 globally (Sarkar et al., 2021). These expected human deaths are significantly attributed to extreme weather conditions that induced morbidity & mortality along with expansions of vector related pandemics. The unbearable economic costs and medication expenditure due to climate change an impact creates burdens on individual, families and countries and eliminate their productivity and development. Health professional from the globe especially from developing countries are extremely worried about this phenomenon that critically reverse progress that has been achieved so far in health discipline (Usman et al., 2022).

1.2.3 Climate change impacts and biodiversity

The biodiversity is one among the most important fatalities of climate change globally, due to fastest emerging reason behind species loss. The numerous species considerably associated at massive level with diverse climate change events. Both the magnitude and the pace of climate change are varying the compatible habitat for living species of terrestrial regions, freshwater and marine among others (Vale et al., 2021). Moreover, the climate changes have impacts on the integrity of ecosystem in various ways such as range shifts, variation in relative abundance, change in timings of activity and use of microhabitat among many others. The geographical stratification among fatalities mainly depends upon their ability to bear environmental circumstances biological interactions, constrains and faces extinctions (Yang et al., 2021).

1.2.4 Climate change impacts and forestry sector

The forest sector is the prime global regulators of climate system that plays indispensable contribution to manage nitrogen and carbon cycles. The unbalance and disturbance in the ecology of forests have macro as well as micro impacts on climate across globe (Zhao et al., 2022). Global warming, environmental degradation and climate change among others are the outcomes of fluctuation in growth and existence of forests. Climate change induces critical influences in traditional structure and functions of ecosystem that impacts forest health such as droughts, forest fire, pest outbreaks and above all the livelihood of animal and humans that largely depended on forest sectors (Dimitrova et al., 2022). Hence, the climate change induces floods, storms and volcanoes put more pressure, augmented situations during winter and surging temperature are the prime hurdle for maintaining the temperature and ecosystem.

1.2.5 Climate change impacts and tourism

Tourism is a commercial activity that plays major contribution in national GDP and has deep rooted with various socio-economic aspects (Gurgel et al., 2021). Tourism is an effective tool for adequate management, potential job opportunities, development of business, revenue generation; enhancing spectacular foreign exchange, promulgation of cross culture activities; entrepreneur contribution and cooperation among national and international organizations eventually enhance national development. Beside the all other sectors, tourism industry is significantly impacted through negative impacts of climate changes. Climate always considers the most important aspect to attract tourist for any specific region and preferred locations (Mei et al., 2020). Different location from cross borders attracts visters due to their specific environment that suits for quality of time and happiness. The massive variations among climate situations such as fluctuated weather patterns, heat waves, floods and storms among others creates serious threats and monumental challenges for economy of host countries and overall development (Ngepah et al., 2022).

Climate change is a growing threat to the world. Extreme weather events, rising temperatures, and changing rainfall patterns will become more frequent, posing a particular threat to developing countries, where social, economic, and political institutions are fragile. If the menace of climate change is not addressed, the socioeconomic problems of developing countries, particularly in south Asia will deepen and erode the gains made in development in the last decades. This concern has spurred research interest in the effects of climate change on socioeconomic indicators. The purpose of this report is to gather evidence and analyze the effects of climate change on socioeconomic indicators in developing countries

2. Objectives of this study

The prime objective of thus secondary study is to assess the impacts of climate change on socio-economic conditions of developing countries and explore the determinants of vulnerability regarding climate change impacts among developing countries.

3. Research Methodology

During recent decades, a large number of empirical evidences collated by the researchers, environmental organizations, governments and allied national and international partners for better understanding the nature, process and impacts of climate change especially among developing countries. Numerous socio-economic, demographic, political and environmental impacts were observed in different context. The prime objective of this study is

to evaluate the social and economic impacts of climate change and also to discuss the determinants of vulnerability that negatively contribute to development countries.

This study primarily incorporates a desk literature review, on the considered issue to understand the nature, scope, patterns and socio-economic impacts so far from the context of developing countries. The underline assumptions for the conceptual model indicated climate change impacts differ from study to study and country to country and the researchers are cautious in developing comparisons among existing studies. At the first step of desk review was to shortlisted the keywords which as basically three broad types such as climate change, socioeconomic impacts of climate change and determinants of vulnerability.

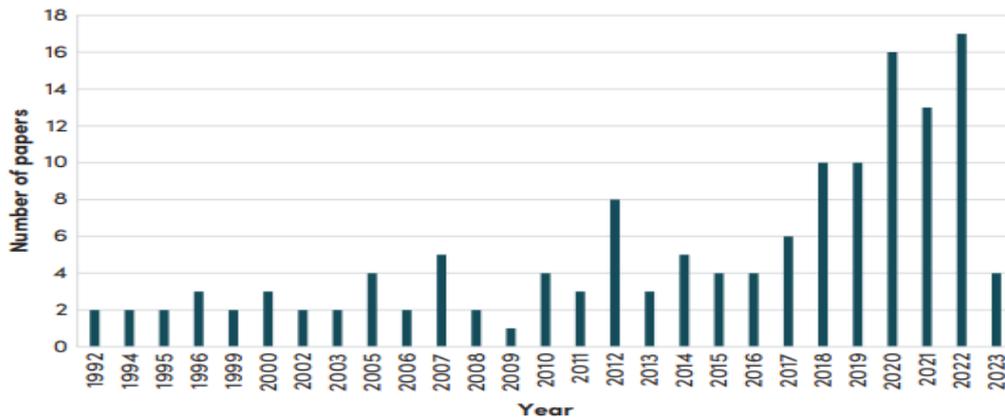


Figure 1: Distribution of studies by year of publications

Various indicators of climate change the following keywords were decided such as temperature, heat waves, global warming, emission, pollution and carbon dioxide. Similarly the keywords for determinants of vulnerability and socio-economic impacts considered such as natural disaster, social welfare structure, economic growth, poverty, health, agricultures, food and water, energy and infrastructure among others. At the next step researchers paired every climate change indicator with socio-economic impacts in developing countries.

At the beginning no geographical and timelines were fixed to review the existing relevant studies and try to established background understanding, intensity, trends and variation of climate change process in developing countries. But latter on third stage researchers carefully focused on the most relevant determinants of vulnerability that primarily caused by climate change. The exclusion and inclusion criteria strictly followed at this stage of the study and try to select only the most related studies that strongly associated with the research questions and objectives.

3.1 Strategy for data collection

For the purpose of data gathering various questions regarding climate change socio-economic impacts and related dominants in developing countries were designed. The priority was given to the relevant quantitative studies because measuring climate socio-economic impacts in developing courtier's strongly associated human behavior and environment. Qualitative literature not ignored the deep inside circumstances at individual, family and community level and also provides quantitatively measured climate change impacts. Beside the qualitative studies, mixed method approach and quantitative studies were also considers for this desk review.

Numerous online search engines such as Google, Google Scholar, Scopus, Web of Science and Springer were selected to review the published research studies. The collected data comprises on various forms such as book chapters, books, research articles, reports, working papers, organizational evaluation studies and conferences papers. The collected data from these databases critically analyses to avoid duplication. After strict inclusion and exclusion criteria researchers gathered to 89 studies from 31 publications outlets, which were interrelated to different search engine and covering climate change impacts on developing countries.

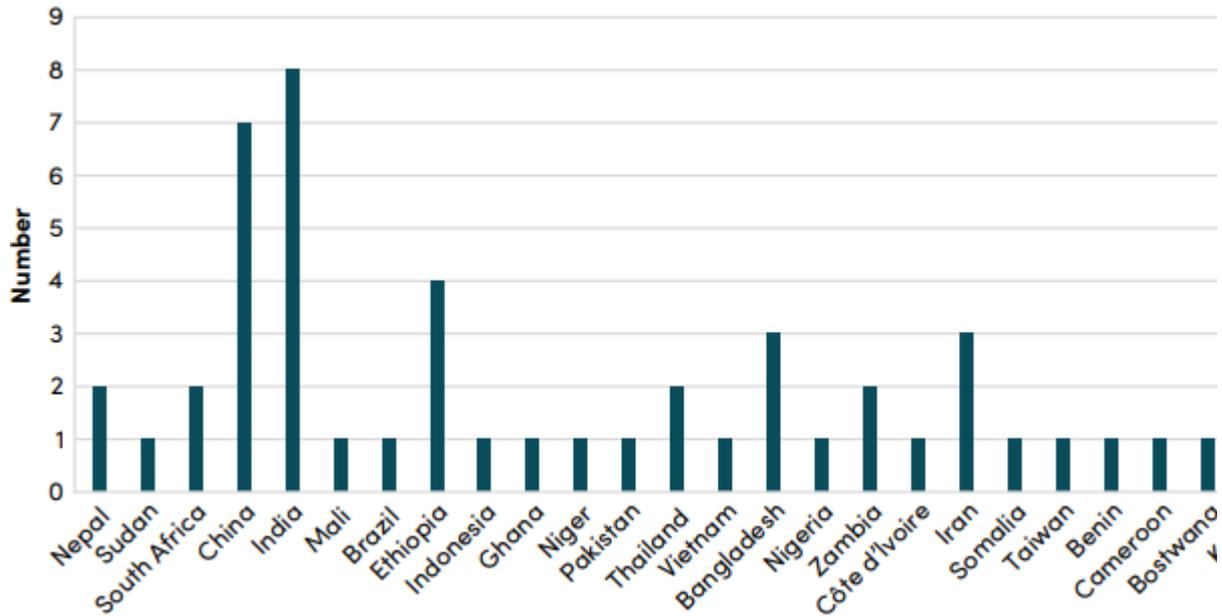


Figure 2: Distribution of studies focusing on developing countries

4. Results and Discussions

The interconnected relationship among climate change and its socio-economic impacts on developing countries has been investigation in this secondary study. Researchers tries to evaluate the climate change impacts and determinants of vulnerability but the situation remains shrouded in ambiguity due to variability of context, fluctuation in temperature patterns according to the country tropical condition, innovation and involvement of technology and variation in adaptive capacity among others significantly contributes as mediating variables to understand the actual situations.

During the period of 1990s, the debate started regarding socio-economic impacts of climate change on individual, family and countries. Important investigation at beginning level by Cline (1992), Fankhauser (1995), Tol (1995) and Abraham et al. (1998) comprehensively discussed the tangible and intangible socio-economic damages on humanity. The results from these studies indicated that the damages from climate change are varies from situation and geographical circumstances and some supporting determinants magnitude these impacts gradually. From that to date, the debate regarding environmental transformation, climate change and its socio-economic impacts on humanity projected at large global scale that leads the national and worlds authorities for uncertainty of policy development.

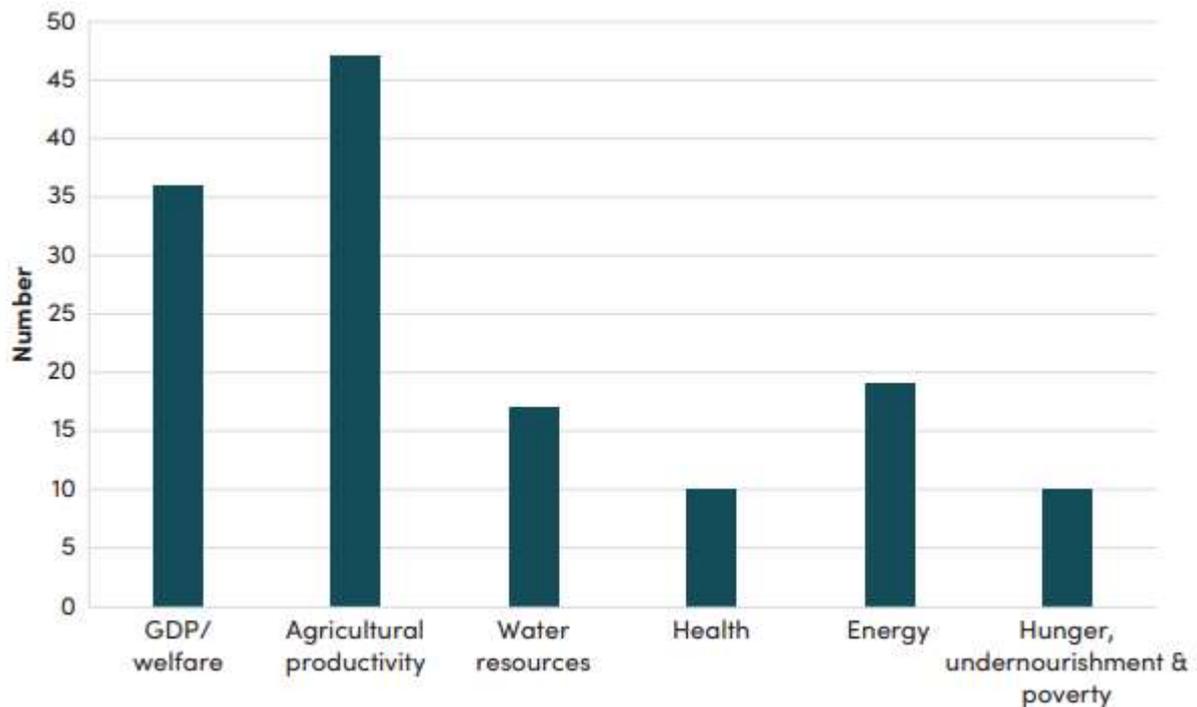


Figure 3: Climate change impacts on developing countries

To understand the socioeconomic climate change impacts various techniques and methods were adopted in existing empirical studies and each effort have different strengths and weakness accordingly. A study by Nordau's (1994), Brouwer et al., (1999) Tol (2002) and Huang (2004) applied enumerative methods in which they cover the physical impacts of climate change. The very nature of this enumerative study highlighted the realistic data regarding damages of physical and natural infrastructure. The economic estimation related to these physical damages significantly impacted the financial conditions and GDPs of affected countries and creates long lasting consequence on government department and allied organization for rehabilitation and restoration. Other studies statistically endorsed the observational data obtain from various socio-economic estimates and related determinants in developing countries. Beside the socio-economic impacts of climate change, there are a lot of factors such as dignity, rituals, cultural fabric of communities, psycho-social attributes among others are significantly associated according to geographical / cross borders situations.

Advancement in technology and economic empowerment established some countries to control or maintain minimum level of climate change impacts explains by Mendelsohn et al., (2000) and Stern (2006) .But the huge proportion of worlds countries especially developing countries with poor economic resources face adverse impacts not only on their economy but all spheres of life such as their human health index, agriculture sector and allied industries, water and food scarcity, poverty index, socio-culture conditions of inhabitant among many others. In addition to these heat waves, flooding, environmental degradation and natural disasters stimulate unproductive economic expenditures and create unbearable burdens on various sectors. Studies by Stren (2006), Safranyik (2008), Crook (2011) and the IPCC (2014) comprehensive argued that the socio-economic of climate change are not universal in nature and intensity. The developing countries of the world across the globe face more severe

consequences that push them more meager socio-economic circumstances and these countries are always at high risks.

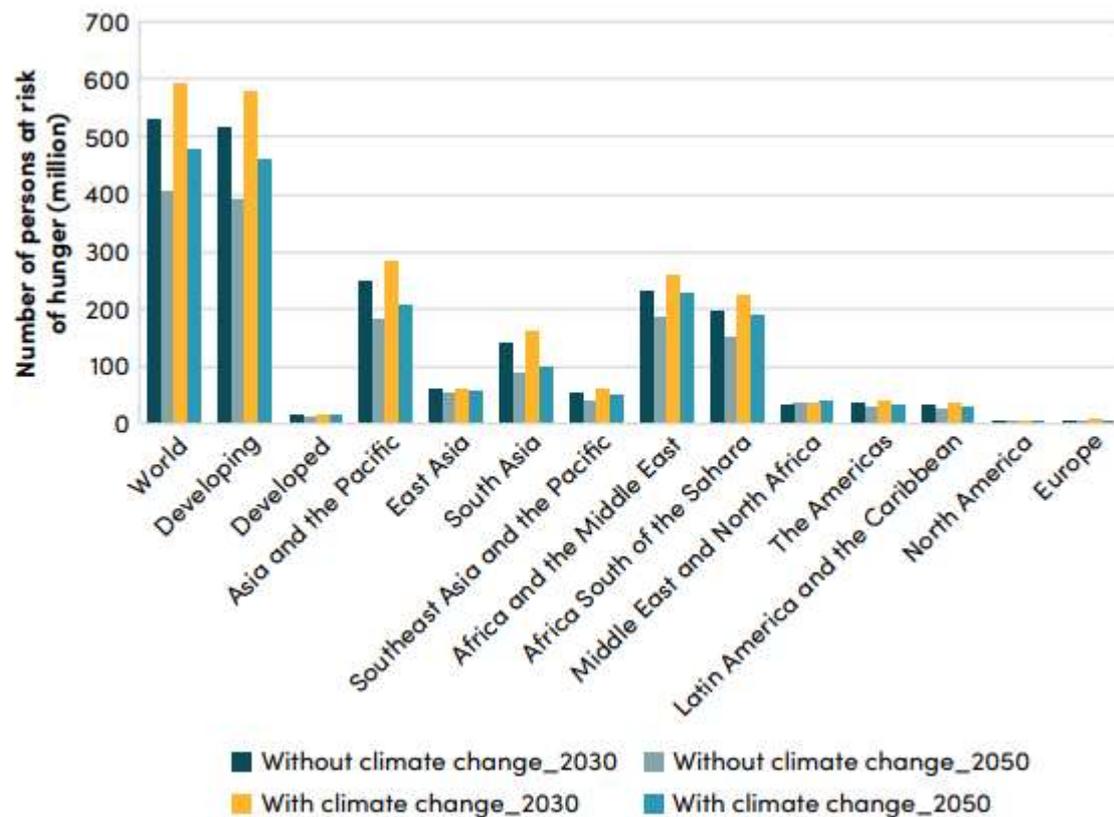


Figure 4: Projected impact of climate change on socio-economic conditions of developing countries

Regional stratification according to climate change impacts discussed by Hashemi (2015), Kundu (2016), Soro (2017) Burke et al., (2018) and the outcomes indicated that the boosts regarding warming & cooler weathers significantly impacted the social, cultural, economic, health and food productivity among affected countries. Unexpected rains or draughts disrupt agriculture and related business and become the major reason of various viral and infectious pandemics. These findings also confirmed by Burke et al. (2018), Wiebe (2019) and AC (2020) provide empirical evidences of climate change socio-economic impacts on developing countries. Uncertainty and critical situation regarding weathers threshold the economic fabric of developing countries beyond the other negative impacts of climate change as report presented by Diffenbaugh et al. (2019). That kind of sensational uncertainty impacts the magnitude of other climate change socioeconomic impacts. Duan et al. (2022) and Astone (2023) represents the study findings and highlighted the association of GDP and the fluctuation in weathers. The findings extended the debates that higher the level of temperature than the median optimum leads towards higher level of uncertainty associated with socio-economic and GDP conditions of countries.

Worldwide socio-economic risks associated with climate change such as droughts studies by Liu et al. (2021), Campagna (2022) and Miron (2023) provide calculations that important determinant of vulnerability in developing nations. The three basic determinants of vulnerability of developing countries such as exposure to deal with droughts, hazard and

vulnerable socio-economic aspects contributes a lot. The report revealed the astonishing predictions that 63% population will be affected during the period of 2046 – 2065 under the circumstances of SSP3-RCP8.5. This situation projected serious threats regarding GDP especially the developing countries of East & South Asia, eastern United States, Mid-western Europe and coastal regions of South America. With climate change, inequality in the future socioeconomic risk of drought among countries is predicted to increase.

The narrative regarding significant impacts of climate change on socio-economic condition of developing countries also supported Signe et al., 2022 and Von et al. 2023 regarding Asian developing countries. These country specific studies highlighted the climate change impacts and important supporting determinants the pushed developing countries towards vulnerable situations. The study reported high level reduction of GDP among affected countries as they shift priorities and focuses from development process.

Conclusion

This desk review study provided an intensive understanding and evidences that climate change has significant impacts on socio-economic conditions of developing countries. There are always various determinants that contribute to the vulnerability process among affected developing countries but the impact varies according to the situations. The climate change impacts cover the whole globe directly or indirectly, some countries might be the least affected but in the long term all economies might be on the losing end. This study revealed the variation among literature from both temporal and spatial determinants of the impacts of climate change and its relationship with socio-economic conditions of developing countries. The prime reason behind this is the variation among various factors such as weather conditions, geographical topography, livelihood, living environments, disease burden and social structure among others.

Above all evidences and investigation findings endorsed the climate change socio-economic impacts are more severe in nature in developing countries particularly in Africa and Asia as compared to other developed world. These astonishing and spatial heterogeneities are clear indications that comprehensive integrated interventions, policy, design and procedure regarding climate change must be considered according to the local context of developing countries. These heterogeneities imply that the largely affected regions of the world and decided priorities. Thus, the experts and resources from the developed world put their contribution and align with designing, adaptation and priority settings towards the most affected developing countries of the world especially from the region of Africa and Asia.

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